

What is claimed is:

1. A reticle, comprising:

5 a first mask portion including a first opaque portion,
a first exposure monitor pattern provided within a first window
portion in the first opaque portion and configured to increase
optical transmittances in a first direction, and a second
exposure monitor pattern provided within a second window
portion in the first opaque portion and configured to increase
optical transmittances in a direction reverse to the first
10 direction; and

a second mask portion including a second opaque portion,
a third exposure monitor pattern provided within a third window
portion in the second opaque portion in a position
corresponding to the first opaque portion upon alignment with
15 a transferred image by the first mask portion and configured
to increase optical transmittances in the first direction,
and a fourth exposure monitor pattern provided within a fourth
window portion in the second opaque portion in a position
corresponding to the first opaque portion and configured to
20 increase optical transmittances in the reverse direction.

2. The reticle of claim 1, wherein the first to fourth exposure
monitor patterns are respectively formed as diffraction
gratings.

25

3. The reticle of claim 2, wherein a pitch of the diffraction

grating is smaller than a width determined by a wavelength of a light source for the exposure using the reticle, a numerical aperture of a lens, and a coherence factor of an optical system.

5

4. The reticle of claim 3, wherein the width is a value obtained by dividing the wavelength by a sum of the coherence factor and 1, and by the numerical aperture.

10 5. The reticle of claim 1, wherein the first mask portion and the second mask portion are provided on an identical mask substrate.

15 6. The reticle of claim 1, wherein the first mask portion is provided on a first mask substrate, and the second mask portion is provided on a second mask substrate.

7. An exposure monitoring method, comprising:

20 transferring a first exposure monitor pattern onto a resist film through a first window portion provided on a first opaque portion by a first exposure dose while allowing the exposure dose to form an inclined distribution in a first direction;

25 transferring a second exposure monitor pattern onto an unexposed portion of the resist film through a second window portion provided on the first opaque portion by the first exposure dose while allowing the exposure dose to form an

inclined distribution in a direction reverse to the first direction;

transferring a third exposure monitor pattern onto an unexposed portion of the resist film through a third window
5 portion provided on a second opaque portion located in a position corresponding to the first opaque portion by a variable exposure dose while allowing the exposure dose to form an inclined distribution in the first direction;

transferring a fourth exposure monitor pattern onto an
10 unexposed portion of the resist film through a fourth window portion provided on the second opaque portion located in a position corresponding to the first opaque portion by the variable exposure dose while allowing the exposure dose to form an inclined distribution in the reverse direction;

15 measuring a first pattern displacement between first and third monitor resist patterns where the first and third exposure monitor patterns are transferred, and a second pattern displacement between second and fourth monitor resist patterns where the second and fourth exposure monitor patterns
20 are transferred;

obtaining a displacement between the first pattern displacement and the second pattern displacement relative to an exposure difference between the first exposure dose and the variable exposure dose; and

25 calculating a fogging exposure dose attributable to the first exposure dose from a displacement value provided when

the variable exposure dose is equal to the first exposure dose.

8. The exposure monitoring method of claim 7, wherein the
5 displacement is expressed by a quadratic expression of the exposure difference.

9. The exposure monitoring method of claim 7, wherein the
first to fourth exposure monitor patterns are respectively
10 formed as diffraction gratings.

10. The exposure monitoring method of claim 9, wherein a pitch
of the diffraction grating is smaller than a width which is
determined by a wavelength of a light source used in the
15 exposure, a numerical aperture of a lens, and a coherence factor of an optical system.

11. The exposure monitoring method of claim 9, wherein the
width is a value obtained by dividing the wavelength by a
20 sum of the coherence factor and 1, and by the numerical aperture.

12. An exposure method, comprising:
respectively measuring first and second fogging exposure
25 doses relative to a first exposure dose for exposing a first mask portion so as to transfer a first image on an inspection

resist film and a second exposure dose for exposing a second mask portion while overlaying a second image transferred through the second mask portion over the first image;

preparing a reticle including the first mask portion, and
5 a substrate coated with a working resist film;

transferring the first image of the first mask portion onto the working resist film by an exposure dose obtained by subtracting the second fogging exposure dose from the first exposure dose;

10 preparing a reticle including the second mask portion;
and

transferring the second image of the second mask portion onto the working resist film by an exposure dose obtained by subtracting the first fogging exposure dose from the second
15 exposure dose.

13. The exposure method of claim 12, wherein the measurement of the first fogging exposure dose comprises:

transferring a first exposure monitor pattern onto the
20 inspection resist film through a first window portion provided on a first opaque portion of the first mask portion by the first exposure dose while allowing the exposure dose to form an inclined distribution in a first direction;

transferring a second exposure monitor pattern onto an
25 unexposed portion of the inspection resist film through a second window portion provided on the first opaque portion

by the first exposure dose while allowing the exposure dose to form an inclined distribution in a direction reverse to the first direction;

transferring a third exposure monitor pattern onto an
5 unexposed portion of the inspection resist film through a third window portion provided on a second opaque portion of the second mask portion located in a position corresponding to the first opaque portion by a variable exposure dose while allowing the exposure dose to form an inclined distribution
10 in the first direction;

transferring a fourth exposure monitor pattern onto an unexposed portion of the inspection resist film through a fourth window portion provided on the second opaque portion located in a position corresponding to the first opaque portion
15 by the variable exposure dose while allowing the exposure dose to form an inclined distribution in the reversed direction;

measuring first pattern displacement between first and third monitor resist patterns where the first and third exposure monitor patterns are transferred, and second pattern
20 displacement between second and fourth monitor resist patterns where the second and fourth exposure monitor patterns are transferred;

obtaining a displacement between the first pattern displacement and the second pattern displacement relative
25 to an exposure difference between the first exposure dose and the variable exposure dose; and

calculating the fogging exposure dose attributable to the first exposure dose from a displacement value provided when the variable exposure dose is equal to the first exposure dose.

5

14. The exposure method of claim 12, wherein the measurement of the second fogging exposure dose comprises transferring the first image of the first mask portion by the second exposure dose onto another inspection resist film, transferring the second image of the second mask portion by the second exposure dose, obtaining another displacement, and calculating the second fogging exposure dose attributable to the second exposure dose.

15 15. The exposure method of claim 13, wherein the displacement is expressed by a quadratic expression of the exposure difference.

16. The exposure method of claim 13, wherein the first to fourth exposure monitor patterns are respectively formed as diffraction gratings.

17. The exposure method of claim 16, wherein a pitch of the diffraction grating is smaller than a width determined by a wavelength of a light source used in the exposure, a numerical aperture of a lens, and a coherence factor of an optical system.

18. The exposure method of claim 16, wherein the width is a value obtained by dividing the wavelength by a sum of the coherence factor and 1, and by the numerical aperture.

5

19. A manufacturing method of a semiconductor device, comprising:

respectively measuring first and second fogging exposure doses relative to a first exposure dose for exposing a first mask portion so as to transfer a first image on an inspection resist film and a second exposure dose for exposing a second mask portion while overlaying a second image transferred through the second mask portion over the first image;

coating a working resist film on a semiconductor substrate;
15 placing the semiconductor substrate and a reticle including the first mask portion on an aligner;

transferring the first image of the first mask portion onto the working resist film by an exposure dose obtained by subtracting the second fogging exposure dose from the first exposure dose;

20 placing a reticle including the second mask portion on the aligner; and

transferring the second image of the second mask portion onto the working resist film by an exposure dose obtained by subtracting the first fogging exposure dose from the second exposure dose.

20. The manufacturing method of claim 19, wherein the measurement of the first fogging exposure dose comprises:

transferring a first exposure monitor pattern onto the
5 inspection resist film through a first window portion provided
on a first opaque portion of the first mask portion by the
first exposure dose while allowing the exposure dose to form
an inclined distribution in a first direction;

transferring a second exposure monitor pattern onto an
10 unexposed portion of the inspection resist film through a
second window portion provided on the first opaque portion
by the first exposure dose while allowing the exposure dose
to form an inclined distribution in a direction reverse to
the first direction;

15 transferring a third exposure monitor pattern onto an
unexposed portion of the inspection resist film through a
third window portion provided on a second opaque portion of
the second mask portion located in a position corresponding
to the first opaque portion by a variable exposure dose while
20 allowing the exposure dose to form an inclined distribution
in the first direction;

transferring a fourth exposure monitor pattern onto an
unexposed portion of the inspection resist film through a
fourth window portion provided on the second opaque portion
25 located in a position corresponding to the first opaque portion
by the variable exposure dose while allowing the exposure

dose to form an inclined distribution in the reversed direction;

measuring first pattern displacement between first and third monitor resist patterns where the first and third exposure monitor patterns are transferred, and second pattern
5 displacement between second and fourth monitor resist patterns where the second and fourth exposure monitor patterns are transferred;

obtaining a displacement between the first pattern displacement and the second pattern displacement relative
10 to an exposure difference between the first exposure dose and the variable exposure dose; and

calculating the fogging exposure dose attributable to the first exposure dose from a displacement value provided when the variable exposure dose is equal to the first exposure
15 dose.

21. The manufacturing method of claim 19, wherein the measurement of the second fogging exposure dose comprises transferring the first image of the first mask portion by
20 the second exposure dose onto another inspection resist film, transferring the second image of the second mask portion by the second exposure dose, obtaining another displacement, and calculating the second fogging exposure dose attributable to the second exposure dose.

25

22. The manufacturing method of claim 20, wherein the

displacement is expressed by a quadratic expression of the exposure difference.

23. The manufacturing method of claim 20, wherein the first
5 to fourth exposure monitor patterns are respectively formed as diffraction gratings.

24. The manufacturing method of claim 23, wherein a pitch
of the diffraction grating is smaller than a width determined
10 by a wavelength of a light source used in the exposure, a numerical aperture of a lens, and a coherence factor of an optical system.

25. The manufacturing method of claim 23, wherein the width
15 is a value obtained by dividing the wavelength by a sum of the coherence factor and 1, and by the numerical aperture.